

**Woodward-Clyde
Consultants****Memorandum**REC'D
5-26-93

To: M. Houlday

From: T. Pisciotto

TECHNICAL MEMO ADDRESSING
HYDROGEOLOGICAL ISSUES
FOR CONDITIONAL APPROVAL
OF PHASE II/I

Office: Wayne, NJ

Date: May 26, 1993

Subject: USEPA Comments on the Ciba-Geigy Phase I Interim Report
and Phase II Proposal - Discussion of Hydrogeological Issues

This memo discusses the approach to resolving USEPA's comments on the hydrogeological issues from the Phase I Interim Report and the Phase II Proposal. The majority of the Agency's comments on the Phase I Hydrogeological Investigation concern our evaluation of the bedrock aquifer and the potential for its contamination from historic site activities. The issues related to these comments are summarized as follows:

does a potential exist for the bedrock aquifer to become contaminated from past site activities because either the till (which is believed to act as an aquitard) is not present in all areas or a downward hydraulic gradient from the overburden to the bedrock is present at certain locations.

is existing information obtained from both the field investigations and the analytical data sufficient for not evaluating further the flow and chemical quality of groundwater in the bedrock.

These issues are summarized from the comments on pages 4-6, 4-7, 4-19, 6-28, 7-13, 7-14, 8-8, 8-17, 12-3, 14-6, Chapter 15 and Table 4-4. These comments can be addressed from additional evaluation of the stratigraphy and the vertical hydraulic gradient between selected shallow overburden and deep overburden wells, and the deep overburden and bedrock wells. Also, a comparison of analytical data from the Phase I Interim Report (Rounds 1 and 2), the Round 3 sampling event (data provided in the March 1992 Progress Report), and the analytical data collected during the Stabilization Investigation are used to evaluate the relationship of contamination with depth. The following is a summary of these evaluations. It is expected that detailed discussions of these items will be provided to the agency after agreement is reached on the manner to address the comments.



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Stratigraphic Considerations Relating to the Potential for Constituent Migration into the Bedrock

The Till unit above the bedrock is considered to be of sufficiently low permeability to deter movement of groundwater from the overburden to the bedrock. The Till unit is present in most locations across the site. The till is not present at the following well clusters: MW-6S/P-18D/RW-3 well, and the MW-17S/17D, P-22S/22D, MW-19S/P-24D. At these locations, the Silt unit which separates the shallow and deep overburden exists at thicknesses ranging from 14 to 38 feet. The low permeability of this Silt unit will deter the migration of contaminants to the deep overburden and bedrock. This is discussed later in more detail.

Comparison of Vertical Hydraulic Gradients Between the Overburden and Bedrock Aquifers

The migration of groundwater from the shallow overburden to the bedrock groundwater system is controlled to a large extent by the hydraulic potential or gradient that exists between the different units or at different depths in the same unit. An evaluation of water level elevations was made at selected well clusters, using the data presented in Table 4-4 of the Phase I Interim Report, to calculate the vertical gradient in different areas of the site. These vertical gradients are presented on the attached Table 1 along with the direction (upward or downward) that groundwater will flow based on these calculations.

The vertical gradients in the different areas of the site are predominantly upward indicating that groundwater from the deep overburden or bedrock has the potential to flow into the shallow overburden. This is somewhat expected due to the presence of the Pawtuxet River, i.e., the river is the discharge point for groundwater in this area. A discussion of the vertical gradients from each well cluster evaluated on Table 1 is as follows:

MW-1S/1D and MW-1D/RW-1 - the downward vertical gradients in the MW-1S/1D well cluster are due to the presence of the bulkhead. The effect of the bulkhead on groundwater flow is discussed in detail in the Stabilization Investigation Report. The gradient between MW-1D and RW-1 data is consistently upward indicating little potential for contamination to travel into the bedrock.

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MW-8S/RW-2 - there is a very strong upward gradient present consistently in this well cluster in the southwest corner of the Wastewater Treatment Area

P-20S/20D and P-20D/RW-4 - a very minor downward gradient was measured on two of fourteen occasions between P-20S/20D and on six of fourteen occasions between P-20D and RW-4. These downward gradients are possibly due to the bulkhead which extends beyond the Production Area to this off-site area.

MW-6S/P-18D and P-18D/RW-3 - a clear pattern of gradients between these three wells is seen on the January 7, 1991, and with more recent data presented in Table 1. These data show a consistently strong upward gradient between MW-6S and P-18D and a minor downward gradient between P-18D and RW-3. The presence of the thick (about 30 feet) Silt unit in this area causes the strong upward gradient between the shallow overburden and deep overburden (i.e the Silt unit confines the deep overburden).

MW-17S/17D and P-22S/22D - consistent upward gradients of 0.5 to 2.6 feet are measured on each occasion provided in Table 1 in each of these well clusters.

MW-19S/P-24D - consistent minor downward gradients of 0.03 to 0.15 feet are measured in this off-site cluster.

Evaluation of Analytical Data from Groundwater Sampled in the Overburden and Bedrock Aquifers

The analytical data obtained from the three rounds of groundwater sampling (Rounds 1 and 2 are presented in the Phase I Interim Report and Round 3 is summarized in the March 1992 Progress Report) were evaluated to determine whether constituents found onsite were detected in the bedrock or if there is a potential for these constituents to exist in areas where the bedrock was not sampled based on the data from the deep overburden well samples. A summary of this evaluation is as follows:

Wastewater Treatment Area - The three sampling rounds from the Wastewater Treatment Area wells - MW-7S, -8S, -9S, -15S, -15D, and RW-2, show the highest VOC and SVO concentrations in MW-15S. MW-15D shows significantly lower concentrations of VOC's and SVO's. Only 37 ppb of SVO's were detected in one sample of three from RW-2. These data indicate significantly decreasing constituent concentrations with depth.

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Warwick Area - The three rounds of sampling from the Warwick Area wells - MW-6S, MW-11S, MW-17S, MW-17D, and RW-3 clearly show a pattern of decreasing contamination with depth. In the three sampling rounds from MW-17D, only 2 ppb of VOCs were detected in one sample and 0.7 ppb of SVOs in another. For RW-3, only 4 ppb and 2 ppb of SVO's were detected in the first and second sampling round. These data also indicate significantly decreasing constituent concentrations with depth

Production Area - Sufficient analytical data has been obtained to evaluate the vertical extent of contamination associated with the Production Area. The Stabilization Investigation Report contains data from both the Hydropunch sampling and the sampling of wells associated with the stabilization activities. These data, together with the three rounds of data collected on wells MW-1S, -1D, -2S, -3S, -4S, -10S, -10D, -12S, -12D, -13S, and -14S, and RW-1 show a clear pattern of decreasing VOC and SVO concentrations with depth. This is most evident at the MW-1S/1D/RW-1 well cluster. MW-1S had 11000 ppb, 21000 ppb, and 18000 ppb of chlorobenzene respectively in the three sampling events (some of the highest levels detected on the site), while the MW-1D samples contained no chlorobenzene, and the three samples from RW-1 contained 1 ppb and 2 ppb of chlorobenzene in the first and second sample, and no organics in the third sample. These samples, together with the analytical data presented in the Stabilization Investigation Report, show little indication of the possibility of bedrock contamination.

Off-site Area - Of the three samples from RW-4, only toluene was detected at 3.5J ppb in the second sampling round.

Summary

The evaluation of stratigraphy, vertical hydraulic gradients, and analytical data clearly indicate little concern regarding the potential for the bedrock aquifer to become contaminated from historic site activities. The main points which support not doing further work in the bedrock and deep overburden are as follows:

In the Wastewater Treatment Area, the presence of the Till unit and a generally thick Silt unit, the strong upward vertical gradients between the shallow and deep overburden and deep overburden and bedrock, and the near absence of VOC and SVO constituents in three samples from RW-2, show no need to either resample RW-2 and MW-15D (comments from

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AND MAKE ARGUMENTS
FOR NO SAMPLING

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p 7-13, p 7-14, and Chapter 15) or to construct an additional deep well in the southwest corner of this area this area (comment from p 14-6).

In the Warwick Area, the upward gradient that exists between the shallow and deep overburden at MW-17S/17D and at MW-6S/P-18D (in all but two measurements), together with the Silt unit which is as thick as 38 feet at the RW-3 location, and the near absence of VOC and SVO constituents in MW-17D and RW-3, show no need to re-sample RW-3 and MW-17D (comments from p 8-18 and 8-17) for a fourth time nor to conduct additional bedrock evaluations in this area.

In the Production Area, additional sampling of RW-1 (comment from p 6-28) is also not necessary because of the presence of the Silt and Till units which limit constituent movement through them, the upward gradient that is present between the bedrock and the deep overburden, and the near absence of VOC and SVO constituents in the three samples from RW-1 despite the high concentrations detected in nearby well MW-1S. The decreasing concentrations of constituents with depth in the Production Area groundwater is supported by the Hydropunch and well sample analytical data collected as part of the Stabilization Investigation.

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Additional sampling of other wells in the Production Area is not warranted at this time. Additional data have been gathered from the sampling of wells installed for stabilization and is included in the Stabilization Investigation Report. Also, additional sampling of the proposed stabilization recovery wells and selected monitoring wells will take place during stabilization.

In conclusion, there is sufficient information obtained to support the conclusions related to the limited potential for the bedrock aquifer to become contaminated from constituents associated with the site. Additional documentation, for which the basis is summarized in this memo, can be provided to USEPA in either a separate report, an addendum to the Phase I Interim Report, or as part of the Phase II report.

Table 1. Comparison of Vertical Gradients Between Selected Wells

	9/13/90	10/25/90	11/27/90	12/5/90	1/7/91	1/16/91	2/19/91	3/12/91	3/21/91	4/15/91	4/24/91	5/15/91	6/25/91	7/22/91
MW-1S/1D	NA	NA	0.07 D	NA	0.07 D	0.04 D	0.07 D	0.17 D	NA	NA	0.22 D	0.50 D	NA	0.03 D
MW-1D/RW-1	0.02 U	0.09 U	0.16 U	0.08 U	0.20 U	0.15 U	0.27 U	0.27 U	NA	NA	0.14 U	0.58 U	NA	0.39 U
MW-8S/RW-2	NA	4.13 U	4.45 U	NA	4.00 U	4.95 U	5.08 U	4.88 U	4.46 U	5.59 U	4.86 U	5.55 U	5.14 U	4.98 U
P-20S/20D	0.64 U	0.67 U	0.32 U	0.06 D	0.05 U	0.49 U	0.02 U	0.10 U	0.10 U	0.09 D	0.12 U	0.02 D	0.30 U	0.14 U
P-20D/RW-4	1.22 D	0.88 D	1.20 D	0.35 U	0.13 D	0.23 D	0.02 U	0.12 U	0.27 U	0.10 U	0.30 U	0.01 U	0.01 D	0.03 D
MW-6S/P-18D	NA	0.87 D	0.25 U	0.51 D	3.39 U	3.50 U	3.55 U	3.86 U	3.54 U	4.01 U	3.56 U	4.08 U	3.97 U	3.89 U
P-18D/RW-3	NA	4.12 U	3.10 U	3.11 U	0.08 D	NA	0.20 D	0.16 D	0.32 D	0.08 D	NA	NA	0.14 D	0.06 D
MW-17S/17D	NA	NA	NA	NA	1.98 U	1.78 U	1.86 U	1.77 U	1.63 U	2.20 U	1.99 U	2.12 U	2.56 U	2.60 U
P-22S/22D	1.97 U	1.58 U	0.80 U	1.35 U	1.08 U	0.95 U	0.98 U	0.50 U	0.83 U	1.33 U	1.17 U	1.34 U	1.78 U	1.85 U
MW-19S/P-24D	NA	NA	NA	NA	0.03 D	0.05 D	0.03 D	0.11 D	0.13 D	0.15 D	0.09 D	0.11 D	0.04 U	NA

Notes:

All measurements are in Feet MSL.

Gradients are calculated by subtracting the one water elevation from the other in the compared well sets. The direction of movement is upward if the deeper well has a higher elevation than the shallow well and downward when the opposite condition applies.

D=Downward

U=Upward

NA=Data not available

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